MORMON CRICKETS

how to control them

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Mormon crickets have been important pests of agriculture in the western part of the United States since it was first settled in about 1848. Great swarms of these insects swept down from the mountains and threatened complete destruction of crops and the ultimate starvation of many of the early settlers. Such migrations into the Mormon settlements in Utah were responsible for the name "Mormon cricket," by which the most important species has since been known.

Mormon crickets frequently reach outbreak numbers and cause serious crop and range losses. In 1954 Federal and State agencies, by treating 122,000 acres of rangeland with insecticide baits, protected untreated crops and adjoining range valued at an estimated half-million dollars from invading Mormon crickets. It is important that ranchers, growers, and others interested in the Mormon cricket problem, know the insect and its habits and understand the latest recommendations for its control.

This bulletin supersedes Farmers' Bulletin 1928, Mormon Crickets and Their Control.

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MORMON CRICKETS

—how to control them

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The Mormon cricket[1] is primarily a western insect. Its range extends from the Missouri River westward to the Cascade and Sierra Nevada ranges and from the Canadian border to northern Arizona (fig. 1). Nevada, Montana, Wyoming, and Idaho have had the most widespread outbreaks. Washington, Oregon, Utah, and Colorado are next in importance, followed by California and South Dakota. Mormon crickets have been reported in Nebraska and North Dakota but never in outbreak numbers.

Range and crop losses

Mormon crickets are less destructive than many other insects. However, the suddenness and severity of their attack on range and cultivated crops and the overwhelming numbers in the attacking bands make them one of the most spectacular and dreaded of all the insect enemies of the western rancher and farmer.

Injury to range plants by Mormon crickets has been rather general over the entire Rocky Mountain region, but most severe on the northern desert shrub ranges in Nevada. More than 2 million acres were reported damaged in that State in 1939, with losses in stock-carrying capacity up to 40 percent. Such loss per acre is not great, since the average carrying capacity is not more than 10 head per section for a 9-month period. However, in normal years range is stocked to the limit. If its capacity is reduced by even 25 percent, the stockman has to lease more range to support his stock. If additional range is not available, he has no choice but to reduce the size of his herd. Many owners are forced to sell breeding stock, which they must later replace at a price likely to be unfavorable. They also lose the income from the breeding stock lost in forced sales.

During the period 1937 to 1949 more than 673,000 acres of cropland in the Rocky Mountain region were damaged by the Mormon cricket. Most of this damage was done before 1942, prior to the extensive use of poisoned bait in control campaigns.

[1] *Anabrus simplex.*

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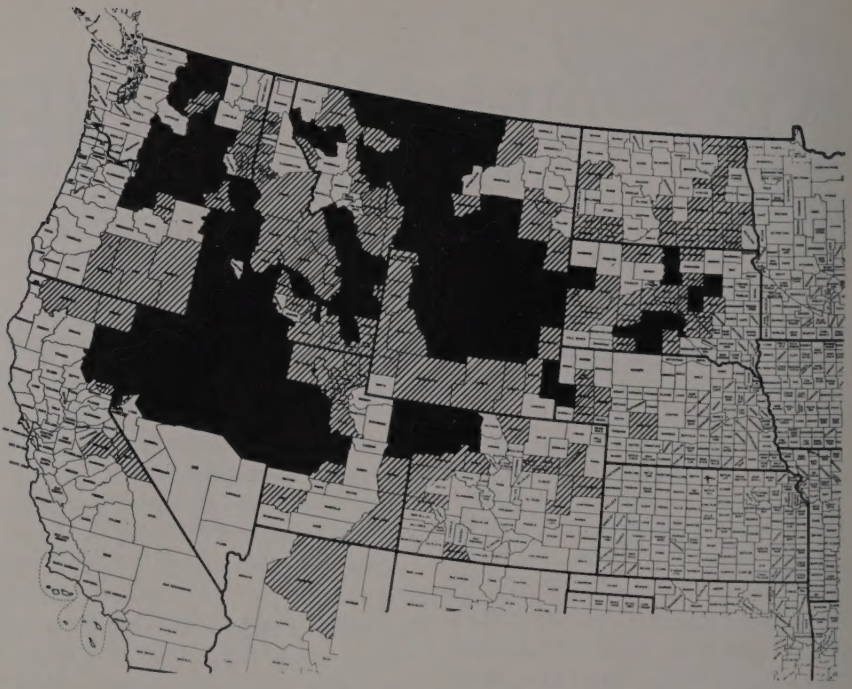

Figure 1.—Distribution of Mormon crickets in the Western States since 1900. Areas in black are those in which cricket control has been necessary at some time during the period 1900–1952. Crosshatching indicates areas where crickets have been reported but not in outbreak numbers.

Damage to crops

In the Rocky Mountain region the greatest injury is done to wheat and other cereals. Most of these crops, especially wheat, are grown on nonirrigated lands and are more susceptible than crops grown on irrigated lands.

Wheat may be injured at any stage in its growth. Cricket injury to the young plants is distinct from grasshopper injury in that the leaves are shredded rather than eaten entirely. With fair moisture most of the plants will recover from this early injury, and usually the only damage is a thinning of the stand. While the wheat is in boot, or just before it begins to head, the crickets cut through the outer sheath and feed on the succulent inner parts of the plant. The heads of wheat thus damaged fail to emerge from the sheath and soon dry up. Perhaps the most serious injury is after the kernels have formed. The crickets remove and eat the kernels, leaving the remainder of the head on the stalk (fig. 2). They injure other cereal crops in much the same way.

Alfalfa is probably second to wheat in the damage sustained. The crickets consume the leaves, leaving only the bare stalks.

Figure 2.—Cricket damage to ripened wheat. Many kernels have been removed and eaten. This is the most common type of injury and frequently is unnoticed until the crop is harvested.

Most kinds of truck crops are eaten by the crickets. Much of the serious damage is done to gardens (fig. 3) of families living on isolated farms who depend largely on what their gardens produce for the year-round supply of vegetables.

Food plants

Mormon crickets feed on more than 250 kinds of range plants. Of these kinds, 47 are grasses, 180 are weeds, and the remainder are browse and grasslike plants. In general, the crickets favor plants with fleshy, succulent leaves, such as balsamroot, dandelion, the mustards, bitterroot, and young Russian-thistle. Most cultivated crops, including small grains, alfalfa, and truck crops, are attacked.

Description and life history

The eggs of the Mormon cricket are about ¼ inch long and rounded at the ends (fig. 4). They are dark brown when first laid, but later become dull gray and enlarged at one end. They are laid just below the soil surface in midsummer. By the time the ground freezes the young crickets within the eggs are fully developed, but they do not hatch until the ground warms in the spring. Hatching normally starts about April 1, but it may begin the last of February. Fall hatching has never been observed in the field.

When they hatch, the young crickets, called nymphs, are about ¼ inch long, and black with white

Figure 3.—Cricket damage to sweet corn.

markings on the edge of the shield just back of the head. Except for size and color, they closely resemble their parents. The nymphs pass through seven stages, or growth periods, separated by molts, or the shedding of their outer skin. When they are about one-third grown, they are light green, tan, or black. After about 60 days they become adults. At first the adults are reddish brown, but they gradually change to dark olive green and finally to nearly black. The female (fig. 5) is larger than the male (fig. 6), and has a swordlike egg-laying organ, or ovipositor.

In about 10 days after becoming adults the crickets mate and the females start laying eggs. One female may lay as many as 250 eggs, although the average number is probably nearer 150. She usually lays eggs for 1 or 2 days, rests for 4 to 6 days, and then resumes laying. Most of the egg laying takes place in the afternoon. During the egg-laying period the males have the habit of "singing" during the forenoons.

A light sandy-loam soil in a well-drained location is usually chosen for egg laying, preferably on a south, east, or west slope. Timbered slopes are avoided, although many eggs are laid in sagebrush areas. The eggs are inserted beneath the soil (fig. 5) in bare spots between grass clumps. In some of the more sandy sections of Washington and Idaho they are laid in the crowns of bunchgrass.

Figure 4.—Eggs of the Mormon cricket, natural size. These eggs were dug from an area 2 inches square.

Unlike grasshopper eggs, which are deposited in a pod, cricket eggs are laid singly. Often as many as 100 are found closely grouped. They may or may not have been laid by a single female. More than

Figure 5.—Female Mormon cricket laying eggs.

likely several females found the spot to their liking.

Special habits

Migration is a pronounced habit of Mormon crickets throughout their active lives. The movements take place on clear or partially cloudy days with air temperatures of 65° to 95° F. and soil-surface temperatures of 75° to 125°, when the wind velocity is less than 20 to 25 miles per hour.

The nymphs are concerned mainly with seeking food or shelter. They form small groups in sheltered places, and later these groups merge into moving bands. By the time the crickets have molted 4 or 5 times, the migrations have become general and the bands may cover hundreds of acres. Migrations continue until egg laying starts. Movements of bands thereafter are away from and returning to the egg-laying beds.

A cricket band performs as a unit. All crickets within the band move in the same direction unless the band is disturbed or is split by some insurmountable object. Even so, they often reassemble after the disturbance or after the object has been passed.

It is not known why a band moves in a definite direction. The direction is not governed by wind, sun, or other climatological factors, nor do the bands always move toward crops or better food.

Crickets can travel from ½ to 1 mile a day. On the basis of 50 favorable days from the time migration starts until egg laying begins, a band may travel 25 to 50 miles in a single season.

Other Mormon cricket activities—feeding, shelter seeking, clustering on warm bare ground, and roosting on brush, grass, or weeds during the heat of the day—are governed by the temperature. Fortunately from a control standpoint, migration and feeding take place within the same range of temperatures. When crickets are migrating, some individuals pause momentarily to feed, even though the band

Figure 6.—Adult male Mormon cricket. Natural size.

as a whole continues its forward progress. When the temperature is too low for migrating, they are usually bunched in sheltered places or on bare spots. When the soil and air temperatures rise above the range favorable for migrating, crickets roost on plants or objects above the ground in a more comfortable air stratum. A study of the reactions of crickets to temperature and other weather phenomena has led to a better understanding of control methods.

Figure 7.—Typical Mormon cricket environment, Independence Mountains, Nevada.

How outbreaks develop

The capacity of Mormon crickets for reproduction is governed in part by the weather. However, the crickets are capable of maintaining themselves in noninjurious numbers in permanent breeding areas even in unfavorable weather. These permanent breeding areas are located in and around mountain ranges of the West, such as the Big Horn Mountains in Wyoming, the Pryor Mountains in south-central Montana, and the Ruby and Independence Mountains in Nevada (fig. 7). When conditions become favorable, the crickets leave these breeding areas and infest adjacent range and farmlands. An infestation may reach its peak in 1 year, but usually 2 or 3 years are required for an outbreak to develop.

Mormon crickets do not increase to outbreak numbers on farms. They migrate from rangeland, and usually their raids on farm crops come without warning and demand immediate action. This is especially true on isolated farms close to their permanent breeding areas.

Control

Control is dependent on the cooperation of farmers, livestock owners, the county and State governments, and all interested Federal agencies. Although individuals can

control local outbreaks, they are soon overwhelmed when large bands of crickets migrate to their croplands from surrounding range areas. It is desirable, therefore, that all agencies interested in cricket control be organized to report impending outbreaks and to prevent infestations from reaching outbreak proportions by controlling them at their source. Control programs administered by the United States Department of Agriculture in cooperation with State and county governments can meet such situations.

Farmers interested only in controlling Mormon crickets on their own land should consult their county agricultural agent or Extension entomologist who can provide them with information on latest control methods. Counties or communities should apply to their State department of agriculture for assistance in organizing and in obtaining bait materials.

Baits

Poisoned baits are the principal means of controlling Mormon crickets (fig. 8). Either a wet or dry bait may be used, depending on the scope of the control effort.

For use by an individual or community, a wet bait is recommended. Most of the bait will be mixed by hand and spread either by hand or with power spreaders (fig. 9).

When Mormon cricket infestations develop into major outbreaks, it is not possible for an individual or group of individuals to cope with the situation, and government assistance is required. Large-scale control campaigns are then necessary. Special equipment for mixing and transporting bait and for spreading it must be provided. Under such circumstances dry baits are recommended. They are especially suitable for application with aircraft or ground dusters.

Figure 8.—Migrating crickets that stopped to feed on poisoned bait.

Wet bait.—To make a wet bait use one of the following carriers:

Standard bran (no shorts or middlings)	100 pounds
or	
Millrun bran, 25 pounds plus sawdust (3 times the bulk of millrun bran)	3½ bushels

Add one of the following insecticides and enough water (8 to 12 gallons) to make a moist, crumbly mash:

Sodium fluosilicate	4 pounds
Aldrin	2 ounces
Chlordane	½ pound
Heptachlor	4 ounces
Toxaphene	1 pound

Sodium fluosilicate is a fine white powder and is not soluble in water. It should be mixed dry with the carrier, and the water added.

The other four insecticides are available commercially as wettable powders or emulsifiable concentrates. If a wettable powder is used, mix it with enough water to produce a thick slurry, add the slurry to the remainder of the water, and mix with the carrier. If an emulsifiable concentrate is used, mix it with the water and then add to the carrier. The dosages recommended above are based on the technical material. From the strength of the wettable powder or emulsifiable concentrate, as given on the label, determine the equivalent quantity of the product that you use.

Figure 9.—U. S. D. A. blower-type, wet-bait spreader mounted on 1½-ton truck. This spreader will bait a strip about 3 rods wide, and will treat 30 acres an hour at a truck speed of 5 miles per hour.

Wet bait can be mixed on a tight floor, wagon or truck bed, or tarpaulin. Mix until all ingredients are thoroughly blended.

Dry bait.—To make dry bait, dissolve an oil solution of one of the insecticides (except sodium fluosilicate) recommended for wet baits

in ½ gallon of fuel or diesel oil or kerosene, and spray the liquid onto 100 pounds of standard bran or steam-rolled wheat. Power bait-mixing machines may be equipped with spraying devices for this purpose (fig. 10). See that the solution is distributed uniformly throughout the carrier. Do not use wettable powder in a dry bait.

Figure 10.—U. S. D. A. continuous mixer. This machine is well adapted to mixing dry bait. The oil-insecticide solution is pumped from the tank on the far side of the truck through spray nozzles mounted at the point where the elevator, center foreground, delivers the bran to the mixing chamber.

How to spread the bait

You can spread wet bait by hand from a wagon or truck or on foot in the same way that you broadcast seed, or you can use one of the mechanical or power spreaders available for this purpose. The spreaders distribute the bait much more economically, rapidly, and uniformly than is possible by hand. Consult your county agricultural agent about power spreaders.

Dry bait can be satisfactorily distributed by airplane or from the ground with single-outlet dusters, but is difficult to spread by hand or with a spreader designed for han-

Figure 11.—Small plane spreading dry bait to protect grain field from crickets moving in from sagebrush range in the background.

dling wet bait. A small plane (fig. 11) can carry approximately 750 pounds of bait and cover 75 acres in about 10 minutes. A large plane can carry approximately 9,000 pounds of bait and cover 900 acres in 20 minutes. Small planes are loaded by hand with bait from sacks, and large planes by means of special equipment (fig. 12).

In heavy infestations (15 to 50 crickets per square yard) broadcast either the wet or dry bait evenly over the entire infested area at the rate of 10 pounds per acre. In extremely heavy infestations (more than 50 crickets per square yard) as much as 20 pounds may be necessary. Where the infestation is moderate or light (less than 15 crickets per square yard) the ground may be strip-baited. This procedure consists in baiting a strip of ground at the rate of 10 pounds per acre and then leaving a strip unbaited. In moderate infestations the unbaited strips should be of about the same width as the baited ones, but if there are less than 5 crickets per square yard it may be 3 times as wide. One hundred pounds of bait will control 5 acres of extremely heavy cricket infestation, 10 acres of heavy, 20 acres of moderate, or 40 acres of light infestation.

Always spread bait **across the direction of migration.** Start the strips in advance of the head of the band and work toward the rear. Since crickets tend to pile up at the

Figure 12.—Loading bait into an airplane.

head of a band and thin out toward the rear, gradually decrease the dosage as their numbers decrease.

Time to spread the bait

Spread the bait at any time of day but preferably while the insects are migrating. If it is spread then, the crickets will feed immediately and results will be evident in 24 hours or less. If it is spread while the crickets are inactive, the percentage of kill will be smaller and effects may be delayed by as much as a day.

Precautions

In handling insecticides follow all directions and heed all precautions given on the containers. Avoid breathing the dust or fumes. Wear a respirator and rubber gloves when handling concentrated materials. Wash frequently with soap and water, and immediately if you spill any material on the skin. Do not wear contaminated clothing.

Foremen of mixing stations should know the symptoms of poisoning caused by the insecticides, and have some knowledge of antidotes and other first-aid measures. If some of an insecticide is accidentally swallowed, induce vomiting by taking 1 tablespoonful of salt in a glass of warm water. Repeat if necessary. Call a doctor.

Store bait where livestock cannot reach it. Do not pile it on the ground. Keep livestock off air strips where planes are being loaded. In loading planes, try not to spill the bait, and clean up any that is spilled on the air strips or in surrounding grass or brush.

When the bait is spread in the amounts recommended, there is no danger of poisoning livestock, poultry, or game birds.

Oil-on-water barriers

The use of oil on irrigation ditches and streams is one of the cheapest and most effective control methods known. Because of its use in recent years, crickets have seldom caused widespread damage to irrigated crops. When migrating crickets come to a stream or irrigation ditch, they plunge into the water, kick themselves into the current, and float. They may be carried along for miles before they come in contact with the shore to start a new infestation. However, with the proper application of oil, the stream promptly becomes a death trap instead of a means of transportation for the crickets.

The common practice is to distribute barrels of oil along the stream at intervals of $\frac{1}{2}$ to $1\frac{1}{2}$ miles. The oil is allowed to drip through a small hole in the barrel onto the surface of the water (fig. 13.)

The proper size of this hole varies in diameter from that of a shingle nail to that of a lead pencil, depending on the size and rate of flow of the stream and the type of oil used. The important point is to maintain a thin, continuous film on the surface of the water. A low-grade distillate is satisfactory. Some of the cheap crude oils film readily on warm water, but most of them contain sludge that clogs the opening

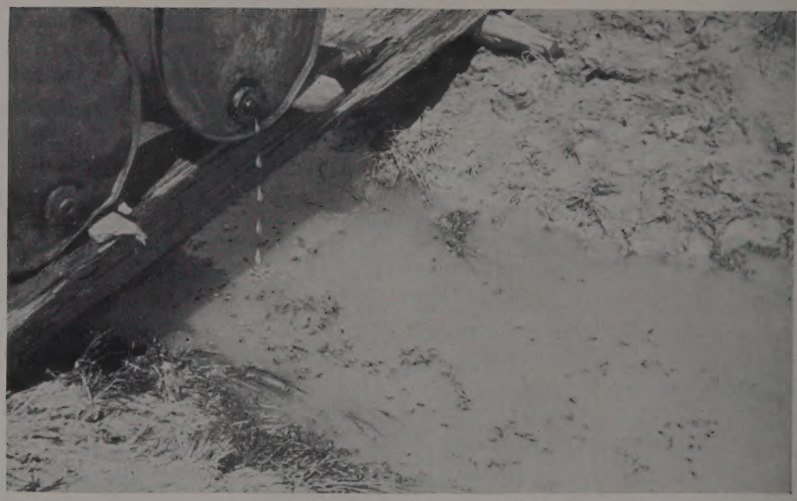

Figure 13.—Barrels dripping oil onto flowing water.

in the barrel. Crude oil is also unsightly on vegetation along stream banks and does not film well on cold water. Although less desirable, crude oil or crankcase oil may be used if distillate is not available.

Water from oiled ditches can be used for irrigation without injury

Figure 14.—Migrating Mormon crickets stopped by a metal barrier. (Courtesy of Nevada State Department of Agriculture.)

to crops if a simple procedure is followed. Where the water is taken out of the main ditch into a lateral, place a baffle board in front of the headgate so that it rests about 2 inches below the surface of the water. In this way the water entering the lateral is drawn off beneath the oiled surface.

Fence barriers

In large-scale control campaigns the use of bait has taken the place of barriers. Strips baited crosswise to an advancing band of crickets check them as effectively as barriers, at much less cost, and with the advantage of killing the insects instead of diverting them. However, if cricket bands appear unexpectedly in a locality, a fence barrier may be used to advantage until bait can be obtained. It is also useful for protecting crops and gardens on isolated ranches from repeated invasions from unbaited rangeland. The barrier most commonly used is a 10-inch strip of 28- or 30-gage galvanized iron set on edge and held in place with stakes driven into the ground on the side away from the migrating bands (fig. 14).

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